

19/14
Zanzibar Protectorate.

Annual Report



ON THE

Agricultural Department

FOR THE YEAR

1933.

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1934.

Zanzibar Protectorate.

REPORT OF THE AGRICULTURAL DEPARTMENT FOR THE YEAR 1933.

STAFF.

The sanctioned staff was maintained with the addition of the Silviculturist still under secondment from Tanganyika Territory for clove research work. The details are as under:—

Rank.	Name.	Period in Residence.
Director	A. J. Findlay, M.A., B.Sc. Agric. (Aber.), N.D.A., N.D.D.	Whole year
Assistant Director	Harold Waterland, Dip. Agric. (Harper Adams)	Whole year
Government Chemist	L. W. Raymond, B.A., B.Sc. Hons (London), A.R.C.S., A.I.C.	May 18th to December 31st.
Manager of Plantations	I. G. C. Squire	Whole year
Agricultural Officers	J. E. Baker, Cert. Agric. (Seale-Hayne)	May 5th to December 31st.
	J. R. P. Soper, B.A. (Cantab.)	January 1st to November 19th.
	J. V. R. Brown, B.Sc. Agric. (Edin.), F.S.I.	January 1st to March 23rd.
	R. Johns, N.D.A., C.D.A. (Aberystwyth), A.I.C.T.A. (Trinidad)	January 1st to May 18th and December 15th to Dec. 31st.
Inspector of Produce	F. B. Wilson, B.A. (Cantab.) Dip. Agric. (Cantab.) A.I.C.T.A. (Trinidad).	March 23rd to December 31st.
Silviculturist	T. M. W. Sheppard	January 1st to December 25th.
	L. G. T. Wigg, Dip. of Forestry (Distinction), B.A. in Forestry (Oxon.), B.A. in Honours School Natural Science (Botany) Oxon	January 1st to June 26th.

Mr. Brown's period of secondment from Tanganyika Territory expired and he was replaced by Mr. Wilson who assumed duty on first appointment on 23rd March, 1933.

It is with deep regret that we have to record the death of Mr. T. M. W. Sheppard, Inspector of Produce, on 25th December, 1933.

THE CLOVE INDUSTRY.

The 1932-33 season crop was a light one of 3,00,000 frasilas and harvesting had been completed by the end of 1932. The review of the crop of that season was made in the report for 1932, and showed that Pemba produced a very light crop of only about 75,000 frasilas, borne almost entirely on young trees. It was to be anticipated therefore that the older trees in Pemba would bear heavily in 1933 and that the total crop would be a substantial one. This anticipation proved correct for in 1933 Pemba produced a main or *Masika* crop of about 6,50,000 frasilas.

The Zanzibar crop for 1932 was above average at 2,25,000 frasilas and was therefore likely to be followed by a reduced yield in 1933, which was the case with a crop of about 1,50,000 frasilas.

The *Vuli* crop of the 1933-34 season was still being harvested at the beginning of 1934, but if we take the estimated total crop for Zanzibar and Pemba for 1933-34 at 8,00,000 frasilas and compare it with crop figures for several previous seasons we find that the generally accepted expectation, that a small crop is almost invariably followed by a good one was realized. Taking the round figures which are used to express the production by seasons, we can see the peculiar seasonal variations in the Protectorate's clove crops and yet realize that there is no definite cycle in production, so that pre-estimations are merely guesses based on an anticipation that a poor crop will be followed by a good one. There is even less reliability in the anticipation that the reverse is true, that a good crop will be followed by a light one as there may be a series of moderate or average crops. A study of the production figures for twelve seasons is interesting and informative:—

Year.	Zanzibar.	Pemba.	Total.
1922-23	3,00,000	7,00,000	10,00 000
1923-24	75,000	2,25,000	3,00,000
1924-25	2,50,000	5,00,000	7 50,000
1925-26	2,00,000	4,00,000	6,00,000
1926-27	2,00,000	5,00,000	7 00,000
1927-28	2,00,000	5,00,000	7 00,000
1928-29	75,000	1,25,000	2,00,000
1929-30	3,00,000	6,00,000	9,00,000
1930-31	50,000	2,00,000	2,50,000
1931-32	2,00,000	7,00,000	9,00,000
1932-33	2,25,000	75,000	3,00,000
1933-34	1,50,000	6,50,000	8,00,000

An examination of the above total figures would seem to indicate that, following a succession of alternation of small and big crops, production might now settle down to another series of average crops. It will be interesting to see if a forecast, based on these figures, of a 6,00,000 crop for 1934-35 is not very near the mark. Present conditions point to the possibility of the correctness of that forecast.

Crop estimates can be given only in round figures, based on the appearance of the actual standing crop. Production figures are

calculated on deliveries to Zanzibar Town and are unreliable because of the difficulty of estimating the proportion of the seasons crop which has been held-over. Export figures are reliable but cannot be correlated with production figures as they may represent the export of cloves from more than one season's crop. There is always a carry-over of stocks from one season to another, even after a short crop season as stockists may be holding for a rise in price, and it is almost impossible to obtain a reliable figure for the amount of this carry-over. The following figures will help to show the divergences and indicate the advisability of dependence on a reliable crop estimate:—

	Estimated Crop.	Arrivals.	Exports.
	Frasilas.	Frasilas.	Frasilas.
1930-31	1,80,000/2,00,000	2,93,113	3,51,735
1931-32	8,00,000/9,00,000	9,43,824	6,96,736
1932-33	3,20,000/3,60,000	4,87,366	5,26,183
1933-34	8,00,000/9,00,000	8,00,825	5,65,674
July/Feb.			

Table No. 1 gives clove crop figures, based on arrivals in Town, for the past 35 seasons.

The harvesting of the 1933 main or *Masika* crop in Zanzibar commenced in June, reached its peak in July and continued in good force well into August. There were a few odd pickings in September and after there was a succession of small-scale ripenings which has directly connected the *Masika* and *Vuli* crops. In some places there was a more or less definite *Vuli* crop harvested in November, 1933, while in others there was a second flush during the first weeks of 1934. It has been a peculiar cropping season, due to abnormal climatic conditions (principally the failure of the 1933 *Masika* rains), in that there has been continuous flowering in small proportion since the 1933 main crop and up to and through the second or *Vuli* crop. It appears this is likely to persist until the 1934 main crop, thus resulting in continuous production throughout a whole crop season, even if the production has been irregular and often on a very small scale. This continuous production has resulted more from irregularity in bearing on individual trees than from wide variation in periods of bearing of individual trees. Thus many trees bore an average crop throughout the year but not a full crop in one flush of clove buds. The ripening was so irregular and uneven that it was sometimes uneconomic to pay for picking, particularly where buds were borne in small quantity on upper and inaccessible branches. Thus possibly as much as 25 per cent. of this intermediate crop was never picked.

Weather conditions in Zanzibar were not favourable for crop drying except during August when there was much cloud and high winds. Delay in drying at that period produced dark coloured, dull cloves.

The 1933 main crop for Zanibar was below average as will also be the whole season's crop when the late *Vuli* crop is taken into

account. It is calculated on Government Plantations that the average production per tree for 1933 main crop was 3.25 lbs. as compared with 3.38 lbs. for 1932.

In Pemba the clove harvest commenced in July in the South, in August in the Centre and not until September in the North. The main harvesting period was short in most districts in Pemba and was finished by the end of October except in the North. As in Zanzibar there was irregular ripening of buds until the *Vuli* crop which came on towards the end of the year and continued in to 1934. The main crop was borne on trees of all ages (in 1932 only young trees had fruited), and may be regarded as a heavy one of over six lakhs of frasilas. In the North there was a certain amount of irregularity in bearing, some trees being almost void of any crop.

Weather conditions throughout the main harvest were excellent and allowed of the preparation and drying of good samples of cloves, which were of good quality and good condition when harvested. The *Vuli* crop being harvested at the close of the year was a light one.

In spite of the fact that large number of labourers—upto 13,000—travelled to Pemba, presumably as clove pickers, labour was difficult to obtain and often troublesome during the harvest. Work was bad, laziness was conspicuous and desertions, before refund of advances, were frequent. There was good deal of dissatisfaction with the picking rates which commenced at three pice per pishi and rose to five and six pice towards the end of the harvest. Clove growers are very slow to appreciate the stage at which a picking rate becomes uneconomic. At present prices of less than Rs. 6 per frasila for Pemba cloves in Zanzibar (representing about Rs. 5 to the producer in Pemba) a picking rate of six pice per pishi is very definitely uneconomic, yet growers will not realize that they are picking at a loss when the rate reaches that stage. Pickers are not slow to realize this weakness on the part of the growers and frame their demands for remuneration accordingly. Production costs must be reduced and it will be greatly to the benefit of the industry when growers will refuse to pay uneconomic picking rates, and rather leave their cloves unpicked than yield to the demands of the pickers, who will have to come into line and be content with smaller but still, to them, remunerative rates.

It is difficult to understand why Pemba should have to import 13,000 pickers to deal with a six lakh (6,00,000 frasilas) crop as was the case in 1933, when it is considered that the African population of Pemba numbers 73,318 of which there should be about 23,000 able bodied men available for clove picking, during the short season in which other work is practically suspended. This does not take into account the women and children who could assist in the clove harvest by gathering and de-stemming.

It is of interest to estimate what size of crop 13,000 clove pickers could deal with in the comparatively short harvest season. If it is

calculated that each picker is capable of harvesting an average of 12 pishis of green cloves (equal to 16 lbs. of dry cloves) per day, then in thirteen months of 24 working days each, one picker should harvest 864 pishis of green cloves equal to 1,152 lbs. or 33 frasilas of dry cloves, which means that 10,000 pickers would harvest a crop of 4,29,000 frasilas in three months. That means an additional employment of 5,181 Pemba pickers to deal with a six lakhs crop, thus leaving an estimated surplus of 17, 819 able bodied Pemba men who take no part in clove picking and thus allow a large amount in wages to go out of the Island.

Climatic conditions during 1933 were quite abnormal and it was fortunate for the clove crop that the *Masika* rains did not fail until after the clove buds had set. Pemba rainfall figures show (see Table VI B) that the rainfall for January was above average, for February slightly below average, for March about normal, but for April and May about ten inches below average in each month. This was followed by an exceptionally dry spell, really a drought, until November when the rains became more or less normal again. The period of drought was favourable for harvesting and drying operations, and did not affect the bulk of the 1933 crop. What the effect is going to be on the 1934 crop is not yet known. The more or less normal rainfall in November and December was not sufficient to compensate for the shortage in previous months with the result that, when a further period of drought conditions intervened in January and February, 1934, clove trees suffered very severely from drought and an alarming proportion, especially young trees, died out. Similar conditions prevailed in Zanzibar.

During 1932 there was a steady decline in the "duty paid" prices of cloves from Rs. 12.31 and Rs. 11.69 in January to Rs. 9.94 and Rs. 9.43 in December for Zanzibar and Pemba respectively. Unfortunately the decline continued during 1933 when prices fell from Rs. 9.54 and Rs. 8.34 in January to Rs. 7.43 and Rs. 6.92 in December for Zanzibar and Pemba respectively. Table No. II in the appendix gives comparative details of prices for cloves and clove stems for 1932 and 1933. Prices have not been so low since the period 1900-1903.

Clove exports for the calendar year 1933 were 6,91,415 frasilas as compared with 5,18,600 frasilas for 1932. The export of clove stems amounted to 1,71,480 frasilas. Tables III and IV give comparative details of exports and destinations.

THE COCONUT AND COPRA INDUSTRY.

Coconut gatherings for the first three quarters of 1933 were well above average and showed a decided increase as compared with the corresponding periods in 1932. There was a decline in the fourth quarter's gathering, but taken all over the year 1933 may be regarded as above average from the productive point of view. On the Govern-

ment Plantations the average number of nuts harvested per bearing tree rose from 31.95 in 1932 to 39.28 in 1933. The palms continued in good condition throughout the year and did not seem to suffer unduly from the prevailing drought. It was only at the beginning of 1934 that the effects of drought became noticeable in the extensive yellowing of leaves.

Although 1933 was a good productive year and domestic exports rose to 2,45,000 cwts. as compared with 2,36,000 cwts. for 1932, it was a poor year for copra prices which fell from Rs. 1.98 in January to Rs. 1.05 in December. At those rates the former doubtful margin of profit to the producer has gone entirely and producers must be selling copra at a loss, for gathering and preparation costs have not fallen proportionately to the ruling local prices. As in the case of cloves, production cost will have to be reduced considerably if there is to be any profit at all in copra production while the present very depreciated prices prevail. The price of whole nuts fell in sympathy with the copra prices from Rs. 15 to Rs. 8 per 1,000.

There has been no change in the quality of copra produced and Zanzibar still has to depend on an admixture of Mainland copra to raise the quality slightly and make its coconut produce acceptable even to the Southern European Markets. There is some good copra produced, but that is absorbed by the local oil mills where the relation between quality and oil out-turn is appreciated. The vast majority of Zanzibar copra producers have always been content to market inferior produce so long as there was any profit to be made; now that there is no profit, the tendency is to expend even less time and care in preparation and realize on their produce with the minimum of delay. They will not appreciate that, even with existing very low prices, an improvement in quality and a reduction in production costs would enable them to command an increased price and so obviate marketing at a loss. There is only one alternative, which is to set a standard of quality for export that they must comply with. The introduction of a system of inspection and grading is therefore more imperative than ever.

The figure for total exports for 1933 is given as 336,000 cwts. as compared with 333,000 cwts. for 1932. Deducting from the quantities imported from the Mainland (91,000 cwts. in 1933 and 97,000 cwts. in 1932) we arrive at domestic exports of 245,000 cwts. and 236,000 cwts. for 1933 and 1932 respectively. Even those figures do not represent the actual production in the Protectorate as a considerable quantity, probably about 15,000 cwts., is absorbed by the local oil mills, mainly for the production of oil for soap making, and there is a large but indefinite consumption of nuts for food purposes. The principal markets for Zanzibar copra are Marseilles and Genoa which took 118,590 cwts. and 214,802 cwts. during 1933. The value of domestic exports for 1933 is given as Rs. 14,03,611 as compared with Rs. 19,13,000 for 1932.

The export of whole coconuts amounted to 925,161 nuts valued at Rs. 24,365. The corresponding figures for 1932 were 876,000 nuts at Rs. 29,000.

Table No. V in the appendix gives comparative details of prices for 1932 and 1933.

DEPARTMENTAL BRANCHES.

Detailed reports of the activities of the separate branches of the Department have been submitted by the Officers-in-Charge. As these reports are not being printed, they are summarized as follows for general information.

EXPERIMENTAL STATION—ZANZIBAR.

The Annual Report for 1932 described the preliminary stages in the conversion of the Kizimbani group of estates to an experimental station which would serve as the main station for the Protectorate for experimental and investigational work. The year now under review constitutes the first complete year in the work of the Kizimbani Experimental Station, but, as the work of conversion started only in May, 1932, the report for 1933 must still be in the nature of a progress report dealing largely with work of a developmental character. The detailed and comprehensive report submitted by the Agricultural Officer-in-Charge, Mr. Wilson, shows the extensive nature of the extra-experimental work that has had to be carried through in order to lay a sound foundation for the extensive experimental programme which has been initiated, and describes the first steps in that programme which involves years of continuous and co-ordinated experimental work before results of real value and reliability can be produced. Long term crops such as Cloves and Coconuts, which we have to deal with here, require prolonged study, and must first be put down to "uniformity trials" in order to ensure reliability in the interpretation of the results of subsequent experimental treatments. Even experiments on annual crops require repetition and replication over a series of years before final conclusions can be formulated as to the value of the crops and their treatments under experimentation. Methods in Agricultural practice must be tried and proved before they are recommended for adoption by the Agricultural community. The lack of trained native staff for routine supervision in field work has been a limiting factor in the progress of experimental work here, but steps are being taken to remedy this by attempting to train the somewhat crude material available.

Staff.—The duties of the Agricultural Officer-in-Charge are not confined to experimental work, for Kizimbani is a Clove and Coconut estate with a planted area of 900 acres which must be managed. The normal European staff should be two Agricultural Officers; Mr. Soper was in charge from January to November and was assisted by Mr.

Wilson from March onwards. Mr. Wigg, the Silviculturist, who is conducting co-ordinated clove investigations, proceeded on leave in June when Mr. Wilson assumed responsibility for his work; from November to the end of the year, Mr. Wilson had to undertake entire responsibility.

The subordinate staff consisted of one Asiatic Superintendent, one Head Overseer, five Assistant Overseers and five pupils in training, Arabs and Africans.

Labour was plentiful but the quality was poor. The labourers take little interest in their work and require the maximum of supervision in order to obtain even a modicum of efficiency. The labour roll for the whole estate numbered about 250.

Weather.—The year was characterized by a long drought. There was quite an unusual fall of rain in January, followed by a dry spell until the beginning of March when the *Masika* rains gave promise of setting in. However there was a break until the end of March when the true *Masika* started only to finish very abruptly on 12th May. The *Masika* definitely failed and it was not until late in October that sufficient rain fell to relieve in a small measure the drought conditions. The *Vuli* rains of October and November were not sufficient to counteract the effects of the previous drought before the advent of the north east monsoon with accompanying dry hot weather.

Thus the year was a most unfortunate one for agriculture and most disappointing from the point of view of the experimental work which had just been started.

Estate Work.—The main road system of the estate was laid down during the year and excellent progress was made in the provision of quarters for staff, labour lines, stores, etc. Altogether twenty semi-permanent buildings and two copra kilns were erected by the Department; two **sakafus* were extended and one re-constructed; and temporary quarters for an European Officer were under construction at the end of the year.

Estate Cloves.—The harvesting of the main clove crop commenced in the middle of June and was completed by the second week in August. The *Vuli* crop was early ripening at the end of the year. The yield of dry cloves from the estate was only 1,325 *frašilas*, a figure well below average. Maintenance expenses were kept low by limiting cultural operations to two slashings and one light hoeing. The drought had the effect of increasing the incidence of "sudden death", and mortality from that disease was high amongst the old clove trees.

Estate Coconuts.—The coconut crop was very good on all sections of the estate, the total yield of nuts being 12,92,613 as compared with 10,69,551 for 1932. Nearly half of the crop was disposed of as whole nuts at prices which fell from Rs. 15 per 1,000 early in the year to

*A *sakafu* is a cement drying floor.

Rs. 8 at the end of the year. The remainder was made into Copra, part of which was sun-dried. A modified type of copra kiln of larger capacity (3,000 - 4,000 nuts) than usual was designed and erected by the Department at a cost of Rs. 460. It has proved very successful.

The palms did not suffer unduly from the drought; they received no cultivation beyond slashing, which was carried out three times during the year.

Transport.—Three draught bullocks are used for estate transport work. They were given new quarters and put on a proper system of rationing, much to the benefit of their health and condition.

EXPERIMENTAL WORK.

Clove Regeneration.—A preliminary trial of a simple method of regeneration was laid down in August 1933 on a one-acre block where casualties from "sudden death" had been fairly numerous. The dead trees were felled and disposed of by removal and burning; the land was ridged and planted with ground crops of maize, sweet potatoes and cassava; the latter has been retained to provide shade for the clove seedlings to be planted in the *Masika* of 1934. Costs and returns are being kept.

Natural regeneration by allowing good natural seedlings to develop in situ is also under trial.

Harvesting Methods.—Four plots of 50 trees each are being devoted to a comparison of careful picking with the usual method in which branch breaking is prevalent.

Cover Crop under Old Cloves.—An attempt has been made to establish a complete cover of *Desmodium ascendens* by selective weeding and also by transplanting cuttings. Two plots were sown with *Calopogonium mucunoides* and *Centrosema pubescens*. Unfortunately drought conditions spoiled this trial, but even under favourable weather conditions it is doubtful if a successful cover crop can be established under closely planted old clove trees.

Uniformity Trials.—An area of mature cloves comprising 600 tree positions was demarcated and divided and a technique for picking and recording individual tree yields developed. Raffia palm ladders were used to facilitate picking and avoid branch breaking. The average yield was 9.76 lbs. of dry cloves per tree position.

COCONUTS.

Tractor Cultivation which had met with some success on the Government Plantations was commenced but had to be abandoned owing to the inefficiency of the tractor which is practically worn out. This experimental block is now under uniformity trial and will be utilized later to test more simple and less expensive implements of cultivation.

Manurial Trials.—A statistical lay-out has been established in a block of 500 mature trees and individual tree records are being kept. Manurial treatments will be introduced when sufficient statistical records have been obtained.

Annual Crops.—An area of some eleven acres was cleared and demarcated to provide eight one-acre blocks, and two half-acre blocks, each subdivided into 1/16 acre plots, and twenty observation plots of 1/16 acre each. These plots are devoted to the following trials.

- (1) *Food Crops.*—Improvement of local food crops by selection of varieties which are superior in respect of yields, quality and disease resistance; introduction of improved strains and investigation of problems of cultivation.
- (2) *Export Crops.*—Trials of exotic crops with particular reference to suitability of climate, yield and quality, and cost of production.
- (3) *Conservation of Soil Fertility.*—Green manuring and crop rotations; the use of lime and artificial manures.
- (4) *Disease Control.*—The investigation and treatment of insect and fungoid pests.

The drought of 1933 militated against the success of our first efforts, but in spite of that, useful information has been obtained as to rates of sowing, time of planting and cultural methods, and a stock of planting material has been built up. A summary of the trials and results may be usefully given.

Maize.—A manurial trial confirmed the suspected deficiency of phosphate in Zanzibar soils.

A spacing experiment indicated an optimum spacing of 18" between single plants in two rows on 5 feet ridges.

A time of planting experiment proved of little value owing to the drought. Only early planted maize matured a crop. Seed selection was started and F 1 generation of selected seed was used for the *Vuli* or late crop. Some excellent samples have been obtained for further work.

Rice.—Eight local varieties of swamp rice were grown and "rogued" to obtain reasonably pure strains.

Five varieties of hill rice from Java made a good start but suffered severely from the drought. Enough seed was eventually obtained for further trials.

Millet (Sorghum).—A severe grass hopper attack completely destroyed this crop in its early stages.

Bullrush Millet.—An early crop suffered the same fate as the Sorghum, but a late crop did very well and gives promise of being a very useful crop for poorer soils and dry weather conditions.

Madagascar Beans did not do well under the weather conditions which characterized 1933, and suffered severely from larval damage in the beans, about 50% of which were rendered useless. A further trial is to be carried out, but the success of this crop under Zanzibar conditions is doubtful.

Ground Nuts.—Both early and late crops were disappointing. The incidence of "Rosette" disease was slight but a "wilt" disease caused a heavy mortality amongst the plants.—Further trials are to be made.

Castor Beans.—Seed germination was poor and a good stand was never established. Sufficient seed was obtained for further trials.

Green Gram.—Planting on the flat either in wet or dry weather resulted in complete failure; ridge planting at the same time gave a good crop. A very late planting, after the *Vuli* rains also gave good results. Native cultivators have had the same experience with planting on the flat.

Cassava.—Four local varieties were planted late in the *Masika* and gave interesting results. The variety *Kuriami* gave a yield of 10,500 lbs. per acre which was about 4,000 lbs. better than any of the others. Mosaic infection was heavy and only one variety—*Msitu*—proved comparatively resistant.

Yams.—Local stock was used for this trial. Sets were planted in June and although the time of germination was irregular and prolonged, a full stand was established by the end of the year, when the crop promised well.

Ginger.—Under ordinary field conditions, the Zanzibar soil is not sufficiently rich for the successful cultivation of this crop.

GREEN MANURES.

- (1) *Mucuna atropurpurea* proved very successful as a short season cover and will be used extensively in future experiments.
- (2) *Calopogonium mucunoides* formed a dense cover when once established and should be a most useful long season cover.
- (3) *Centrosema pubescens* was slower in growth in the initial stages and did not form so dense a cover as *Calopogonium*, but had a longer growing period; also a very useful long season cover.
- (4) *Tephrosia candida* has done very well and is likely to be most useful as an erect cover which will stand frequent lopping.
- (5) *Crotalaria* (*junceae* and *striata*) were rather irregular in growth.
- (6) *Phaseolus carcaratus* formed a useful cover in spite of poor germination and is worthy of further trials.

(7) *Phaseolus aconitifolius* failed to germinate.

(8) *Lupin*. A dwarf lupin from the Highlands of Kenya proved unsuitable for Zanzibar conditions.

Orchard.—An area of about five acres was cleared and laid out as an orchard site to be planted up with a collection of tropical fruits. The following have been established in the orchard:—

Banana varieties
Pineapple varieties
Pawpaw varieties including Hawaiian
Limes
Jack Fruits
Durian
Mango varieties
Mangosteen
Eugenia spp.
Chinese guava
Anona spp.
Averrhoa carambola.

Further stock is being raised in the nursery for 1934 planting.

Nursery Work.—The details of nursery work, which was organized and very largely carried on by the Silviculturist, have been included under the heading "Clove Investigational Work".

LIVESTOCK.

Bullocks.—Estate transport is carried out by three bullocks with single-bullock carts.

Poultry.—In March, 1933, the two pens of Rhode Island Reds imported from Kenya in October, 1932, were put under re-organized feeding and management, the benefit of which is clearly indicated with the following egg yields from 16 hens for the year:—

January-March	April-June	July-September	October-December
181	432	483	654

Two, of the original 18 stock hens, died early in the year; the remainder, with the two cockrels, remained in good condition.

The following "balanced" ration was evolved and proved so suitable that it has been adopted as the standard feed.

Daily Ration :— (1) *Grain*. 2 oz of maize, Sorghum and Bullrush Millet (Maweles).

For Laying Birds :—(2) *Mash*. 2 oz of the following mixture :—
3 parts bran
1 part maize meal
1 part millet meal
1 part coconut meal
10 per cent. dried shark
2 per cent. mineral mixture

(3) Green food and crushed oyster shell.

For young growing stock 20% of dried shark is included in the Mash.

Owing to accommodation being limited, prior to the provision of the new poultry runs in November, breeding had to be restricted, but

between June and September 70 chicks were hatched, out of which after allowing for culls and deaths, 53 were alive and healthy at the end of the year. It was found that eggs lose their viability after six days and that the best hatching period in Zanzibar is from April to August. Early maturity, probably due largely to high protein content of the ration, was evident amongst the pullets, many of which commenced laying before they were six months old; it is said that local native fowls often take nine to twelve months to attain maturity.

A new design of portable house capable of holding about 40 chickens up to pullet size was designed, made on the station and brought into use with very good results. The total cost per house is only Rs. 40. The incidence of disease was slight; "fowl pox" amongst growing chickens was the principle trouble, but yielded to treatment in the majority of cases.

During the year 1,032 eggs were sold in Zanzibar at 4 annas each for setting; infertile eggs were replaced; also 55 eggs were sent to Pemba to form the nucleus of a stock of poultry there.

EXPERIMENTAL STATION—PEMBA.

The stations in Pemba may be regarded almost as sub-stations of central experimental station at Kizimbani in Zanzibar for they are utilized largely for putting to trial under Pemba conditions, experiments which are being more intensively studied at Kizimbani. Also they will serve as demonstration centres at which methods, tried and proved by experimentation, will be put into practice and developed as being improvements which could with advantage be studied and adopted by local agriculturists.

It is in order to disseminate as readily and efficiently as possible the knowledge of improved methods that these stations have been established in or near the three principal agricultural areas in Pemba. In the centre of the island is situated Chake Chake, where the Headquarters of the Department in Pemba have been established, and within four miles lies Wesha, the experimental station for the Central area. Across the creek from Wesha is the Tundaua estate which is being developed more as an estate than an experimental station. In the northern area, it was found necessary to establish two stations at Matangatwani and Makondeni in comparative close proximity in order to provide facilities for investigations on all crops, permanent and annual. In the southern area, Fufuni was chosen as a suitable and representative station.

All these stations were formerly Government Plantations, operated as typical clove and coconut estates. Experimental and demonstrational work is now combined with estate management. As the work of the re organization was commenced only in the latter part of 1932, activities during 1933 were still confined to developments of the initial stages of experimental work.

Staff.—The normal European staff required to carry out an experimental programme and manage five estates should be two Agricultural Officers, but it was possible only for three and a half months to have the full staff in Pemba. Messrs. Brown, Johns and Baker were successively in charge of the department's work in Pemba.

The field staff consisted of seven African Assistant Overseers and seven African Headmen.

Weather.—The year 1933 was one of the driest on record. There was ample rainfall in January followed by the usual dry spell before the advent of the *Masika* rains which were much below average and ceased suddenly in May. This was followed by five months of drought conditions and it was not until November that the rainfall returned to more or less normal. The total for the year was fully 20 inches less than the average for the last 33 years. Details of rainfall and temperatures are given in Appendix VI B.

Labour.—Plantation labour in Pemba consists almost entirely of Mainland natives; the supply was plentiful and fairly efficient. Labour for clove picking, recruited from Zanzibar and Pemba natives, was often scarce and unsatisfactory. The health of the labour forces on all the stations was exceptionally good. The daily rate of pay was reduced in April from 9 annas to 8 annas.

ESTATE WORK.

Cloves.—Clove crops were generally good, particularly at Fufuni where picking commenced in July; the crops at Wesha and Tundaua ripened a month later while picking in the northern area was not in full swing until September; the harvesting period was short and was finished by the end of October except in the north. The picking price commenced at three pice per pishi and rose to five pice towards the end of the harvest. The quality of the cloves as harvested was very good and under favourable drying conditions, excellent samples of dried cloves were produced. In the south and the centre of the island, cropping was well distributed in old and young trees; in the north cropping was very uneven, some trees bearing practically no crop. A light *Vuli* crop was being harvested at the end of the year. 2,688 frasilas of dry cloves were produced from all five stations.

Coconuts.—At Tundaua the new underground type of copra kiln was completed and operated along with the four old kilns. Drought conditions allowed of the preparation of a considerable quantity of sun-dried copra of good quality. The new type copra kiln built at Fufuni with concrete blocks, reinforced concrete drying floor, and a sliding roof of corrugated iron allowed of sun drying as well as kiln drying and speeded up the drying process. An improvement in the design could be made by providing more ventilation under the sliding roof.

Copra prepared on the experimental stations amounted to 1,885 frasilas; 17,497 whole nuts were sold.

Buildings.—An extensive building programme was carried out during the year. All buildings are of a semi-permanent type, erected by local contractors under departmental supervision.

At Wesha three native staff quarters, eleven labourers houses, a poultry-keeper's house and store and poultry pens were erected.

At Tundaua nineteen labourers' houses and a copra kiln were completed. At Fufuni ten labourers' houses were built, and at Matangatwani an overseer's house was provided.

Experimental Work.

Cloves.—Clove nurseries were established at all stations. At Fufuni the December, 1932, sowing of 10,505 seeds from nine selected trees germinated well and produced fine seedlings which were later on given different treatments. Seedlings hardened-off in the original seed beds, after thinning, and those transplanted to a hardening-off bed made good growth. Banana fibre pots used for transplanting rotted quickly and had to be renewed frequently. Further nursery stocks from selected trees were established at all stations at the end of 1933 and sites were selected and prepared for central nurseries on land lent by private plantation owners at Kish Kash, Mzambaraoni, Mlianjini and Mkunga.

A shade experiment of five one-acre plots was laid down at Fufuni, the shade trees used being *Gliricidia maculata*, *Albizzia mollucana*, *Pterocarpus indicus* and *Cassia siamea*; the control plot has no shade.

A small trial of planting at stake in rides cut in secondary bush was not successful owing to the drought but will be renewed in 1934.

An establishment trial to compare *Vuli* with *Masika* planting was laid out on a statistical basis. Selected seedlings from nine parent trees were put out as seed tree lines; nine lines, each with 30 seedlings. An area of four acres has been prepared for a regeneration experiment. At Makondeni an area of ten year old clove trees has been demarcated into nine blocks of 50 trees each and prepared for cultural experiments.

Seven blocks of old clove trees have been marked out for future experiments and an area of four year old clove trees is being laid down to a cover crop experiment.

At Matangatwani three one-acre plots of clove trees planted in 1929 were sown to cover crops of *Tephrosia candida*, *Crotalaria striata* and *Calopogonium mucunoides* and a fourth plot used as a control with open cultivation; the *Tephrosia* and *Calopogonium* covers did well, but the *Crotalaria* was poor and died out early; it has been replaced by a cover of *Mucuna atropurpurea* which has made good growth.

Coconuts.—At Tundaua a block of five one-acre plots was devoted to a planting and cultural treatment experiment. Seedlings were

planted in April-May 1933 at 28' x 28' triangular and the following treatments applied:—

1. *Calopogonium mucunoides* cover crop.
2. *Tephrosia candida* cover crop.
3. Open cultivation.
4. Ring cultivation and slashing inter spaces.
5. Control, slashing only.

Present progress is satisfactory. 4,771 coconuts from selected palms have been put in nurseries at the various stations to provide seedling supplies for experimental work, distribution and gapping existing coconut areas.

Citrus Fruits.—The first crop from grape fruit and local orange trees in the Wesha plot was harvested, and the plot extended by planting with budded grape fruit and pineapple orange from Zanzibar stocks. Citrus plots from the same budded stocks were planted up at Fufuni and Matangatwani and promise well.

Cover Crops.—Trials were carried out at four stations with the following results:—

Tephrosia candida. Slow to start but afterwards formed an excellent erect cover.

Crotalaria striata. Germinated well but subsequently died out on account of drought; not promising.

Crotalaria juncea. Produced a good cover but died down quickly.

Calopogonium mucunoides and *Centrosema pubescens.* Very promising long season covers.

Indigofera arrecta. Slow at first but eventually produced a good cover.

Indigofera endecaphylla. Failed.

Mucuna atropurpurea. Where seed germination was good, has done exceptionally well, as a short term cover.

Food Crops.—The trials of Java "upland" rice at Fufuni failed owing to drought, which also adversely affected the local swamp rice under trial at Tundaa. These trials will be repeated in 1934. Madagascar beans at Fufuni did not succeed and maize crops at Wesha and Matangatwani suffered severely from drought; a *Mucuna* cover was put down in preparation for 1934 planting on an extended scale.

Poultry.—A poultry farm was started at Wesha. Rhode Island Red eggs were supplied from the Kizimbani pens and at the end of the year there was a stock of 27 young birds all doing well.

CLOVE INVESTIGATIONAL WORK.

The investigations in nursery practice, started at the end of 1932 by the sowing of the first lot of seed from fifty-one selected trees, were continued by Mr. Wigg, the Silviculturist, until he went on

leave in June, 1933, when Mr. Wilson took them over with his other duties and continued in charge until the end of the year.

The selection of seed trees was made upon the following main considerations:—

Heavy bearing of many flowered tassels, good shape for easy harvesting by climbing, single bole to ensure single mother tree, dark luxuriant foliage, general vigour, and large sized buds. It is problematical whether any of these characters are innate in the tree or merely the result of environmental factors. Considering the accepted history of the introduction of the clove, which was—the secret removal of contraband plants from Amboyna to Mauritius or Reunion, the transport of a few seedlings thence to Zanzibar and the subsequent planting up of Zanzibar and Pemba from the seed of possibly only one or two survivors of these—an extremely rigorous accidental segregation has probably occurred which may have resulted in a very uniform tree population.

Only seed from the selected trees was used for sowing and a further selection was made by rejecting inferior seeds after they had been treated by soaking in water for two or three days in order to remove the fleshy pericarp.

A nursery record is kept which gives the origin, history and progress of all planting material reared in the nursery.

During the year a variety of methods of sowing were tried and eventually it was decided to adopt the following as the standard method. The beds are carefully cultivated and made up and a fine tilth obtained which is consolidated by the use of a 6" diameter wooden roller fitted with longitudinal batons which mark out the 6" rows for planting. A baton fitted with pegs $1" \times \frac{1}{2}"$ spaced at 3" is then used to mark the seed positions in the rows. The hulled seed is then lightly pressed into the soil in a vertical position with the radicle pointing downwards. The whole bed is then covered with old dry clove leaves which form a protective mulch conserving soil moisture, protecting the delicate cotyledons from sun scorch and preventing the formation of water gulleys on the surface of the bed during heavy rain or watering. The bed is further protected by the erection of palm leaf shade at height 6'–6". After germination which takes place in about 20 days, the leaf mulch is removed from above the rows of small seedlings and later on inter-row cultivation is carried out as required. By this method a high percentage of germination is obtained, which seldom falls below 75% and generally reaches 95%.

Experiments on the subsequent treatment of the clove seedlings aimed at the economical production of a sturdy transplant which could readily be removed, transported and established on clove estates. In other words the problem was how to produce a hardened-off plant with a full equipment of sun leaves with the least mortality and the least expense in manipulation. In order to solve this problem several treatments were tried, the first of which was transplanting

into a hardening-off bed in which various types of natural shade had been established. Owing to the drought, the growth of the natural shade of tephrosia and crotalaria was most unsatisfactory, and artificial shade and frequent watering had to be resorted to. In spite of this the drought prevailed with a consequent plant mortality so high that the experiment proved a failure. The anticipated advantages, to be derived from this treatment in the formation of a bushy root system with a short tap root which makes for ease in lifting and greater root activity when planted out, are such as to justify further trials under more favourable climatic conditions.

The use of dried banana fibre pots was the second form of treatment. These pots are very cheap to make in the first instance, but the method becomes expensive because the pots rot too quickly and have to be renewed. Not only that, but the re-potting caused a cramping of the root system (Plate A). This method cannot therefore be recommended.

Bamboo pots were given a thorough trial as another form of treatment, but the only pots available were of too small a diameter, with the result that the root system of the seedling was cramped (Plate B). It is considered that this would be a useful method if more suitable size of bamboo pots were readily available. The Giant Bamboo has been introduced with a view to supplying future requirements.

The fourth treatment was to leave the seedlings in the nursery beds until just before the planting-out time. These left at the original spacing of 6" x 3" were found to be too close, but 6" x 6" staggered i.e. in zig-zag order espacement allowed of the plants being conveniently lifted with balls of earth and packed in rough pots of green banana fibre in preparation for transport to the planting site. The lateral roots had to be pruned to facilitate lifting and potting, but this process did not seem to adversely affect the seedlings (Plate C). This method of transplanting from nursery beds to banana fibre pots even some time before the planting season seems to promise well as being cheap and reliable (Plate C).

As a comparison to the above treatments some natural seedlings, such as were used and are still used by many shamba owners, were lifted with balls of earth and potted in green banana fibre. These were taken to town and photographed. The sparse nature of the seedling shoot and leaf equipment, and its exceptionally poor root system as compared with late potted nursery plants are clearly illustrated in Plate D.

In spite of very unfavourable weather conditions and lamentable lack of experience on the part of the headmen and labourers employed in the nursery (they were doing this class of work for the first time), much valuable information was accumulated. The general conclusions reached were that late potting of plants with balls of earth into dry banana fibre pots was a promising method, while plants left in

situ as long as possible and transferred with balls of earth into green banana fibre pots in readiness for early transplanting proved very satisfactory. The experience of hardening-off in such a dry season led to the conclusion that the clove plant cannot be led up to the no-shade and no-water treatment without great loss in the very hot periods before the planting rains if increased shade protection and occasional watering are not resorted to. Also it has been found that the production of tough-shooted plant with a full equipment of sun leaves should be done chiefly between July and mid-October.

That the mortality was extraordinarily high owing to drought and inexperience in labour, is shown by the fact that out of nearly 50,000 seedlings reared only 9,929 were finally available as planting material.

The first planting experiment designed to compare the *Vuli* and *Masika* seasons for field planting and the effects of different nursery treatments was started in November when the first plot in a Latin square lay-out was planted up. Planting was done in favourable weather but this was soon followed by very hot dry weather which resulted in a 10% loss of plants. A site for planting up 36 lines of seed trees was laid out and planted up with *tephrosia candida* throughout and permanent shade trees of *Glyricidia maculata*, *Erythrina velutina*, *Albizia mollucana* and *Cassia siamea* in one half to study seedling establishment and sapling growth with and without overhead shade.

Individual tree records are being kept and phenological observations on shoot and inflorescence development are being made. A study of the fertilization of the clove flower is in progress. A number of saplings varying in height from five to fifteen feet were topped at various heights as a preliminary investigation on the effects of topping on final tree shape and fruiting. The immediate effect in most cases was considerable bud activity.

Numbers of "sudden death" trees were examined and specimens of diseased material collected for identification of possible fungus infection. A study of the root system of the clove tree was also commenced.

The Silviculturist also assisted in collecting information on Mangrove areas and started a trial of tree planting on "wanda" or "coral rag" country.

GOVERNMENT PLANTATIONS.

Further progress was made in the scheme for the disposal of properties which were considered unsuitable for retention as Government Plantations but were acceptable to private owners; six properties were sold for Rs. 1,00,120 representing values which are considered satisfactory under existing conditions of depressed produce prices. The basis of valuation was Rs. 4 for a bearing clove tree and Rs. 3 for a bearing coconut palm.

The process of separation of the Plantations Branch of the Department was completed during the year when the Branch was given control of its own cash transactions and allowed to deal direct with the Treasury. This has allowed of the establishment of a system of accounting which reveals the true financial position of individual plantations or groups of adjoining plantations now operated as single estates. Thus the system of operating the Government Plantations is now as nearly as possible on a strictly commercial basis.

Disappointingly low prices for plantation produce—cloves and copra—are reflected in the final statement of the year's operations which show an excess of expenditure over revenue to the amount of Rs. 1,503-20 in spite of substantial reductions in estimated expenditure. An examination of the financial statement shows that losses were sustained on the coconut shmbas, which was only to be expected as copra making is definitely unprofitable while ruling prices, even for good quality, are so low—in the region of Re. 1 per frasila.

The two main estates, Machui and Selem, show losses of Rs. 2,292 and Rs. 786 respectively, but if we consider the expenditure of over Rs. 3,500 on the reconstruction of "sakafus" as being really a capital expenditure, then there is a balance just on the right side. The sale of certain plantations must also be taken into account as they had to be maintained for the first portion of the year and were sold just prior to the clove harvest. The financial position at the end of the year may be summarized thus:—

	Rs. Cts.	
<i>Revenue.</i>		
Coconuts	...	58,434 53
Cloves	...	36,308 03
Miscellaneous	...	1,335 81
Total	...	96,078 37
<i>Expenditure.</i>		
Headquarters Charges	...	16,690 20
Field Staff	...	12,353 19
Labour	...	56,892 41
Other Charges	...	11,640 77
Total	...	97,581 57
Excess of Expenditure over Revenue	...	1,503 20

This does not take into account an item of Rs. 5,607-92 being Special Expenditure on Plantation Surveys.

Owing to the sale of properties and the transfer of estates to the Experimental Stations Branch, the figures for 1933 are not strictly comparable with those of 1932, but a comparison will indicate how expenditure was reduced in an endeavour to keep pace with falling revenue thus:—

	1932.		1933.	
	Rs.	Cts.	Rs.	Cts.
Revenue	...	2,01,935 23	96,078 37	
Expenditure	...	1,91,367 53	97,581 57	

The stage was reached during the year when a difference of a few cents in produce prices converted profit into loss or vice versa in production. This scarcely applies to copra, the price of which had fallen to an unprofitable level very early in the year and continued to fall. If the Government Plantations were managed on a strictly economic basis, as a close examination of costs would show that they were, and showed a loss in working, it is obvious that privately owned plantations, encumbered with mortgages, were definitely not profit-earning, except perhaps in the case of small holdings where the owner and his family picked the clove crop; even they would earn but a bare living.

As Government Plantations are practically non-existent in Pemba now (having been transferred to Experimental Stations), the following remarks apply only to Government Plantations in Zanzibar.

CROPS.

Cloves.—The clove harvest was a peculiar one in many respects; it really commenced in June when some plantations yielded very appreciable pickings; in July it reached the peak on most plantations, and in August the production dropped to less than half of that in July. Picking, however, continued for the remainder of the year, showing a definite increase in November as compared with October and December. But even the end of the year did not see the finish of production for quite heavy pickings were anticipated for January and February, 1934.

The peculiarity of clove harvest was entirely due to the abnormal climatic conditions which characterized 1933. The *Masika* rains suddenly failed in the middle of May and a drought ensued which lasted more or less until the middle of November. During these six months, less than a quarter of the year's total rainfall was recorded. The effect of the abnormal weather conditions was extreme variability in production on individual trees; that is to say, parts of trees flushed at varying times instead of individual trees flushing all over. This made picking difficult and expensive, as a high picking rate was not warranted with cloves selling at about Rs. 6 per frasila; the result was that in many cases about 25% of the crop was left unpicked.

Only one plantation produced more than the average of 5 lbs. per bearing tree: Kitope gave 5.25 lbs. per tree, while the general average for the Plantations was 3.247 lbs. per tree for the main crop. The main crop of 5,090 frasilas was below average.

The dry season was favourable for the production of good quality cloves. The average loss in drying was 67.57% and the proportion of stems worked out at 22.6%.

The picking price commenced at three pice per pishi, this was advanced to four pice on 24th June and again to five pice on 3rd August. There was a slight shortage of pickers at the height of the

harvest in July although the Pemba harvest was not then in full swing.

The extraordinary variation in clove production is well illustrated in the production figures for the Masingini and Dole estates which were 2,720 frasilas in 1932 and 45 frasilas in 1933 for the former and 244 frasilas as compared with 10 frasilas for the latter.

Owing to essential reduction in expenditure, only maintenance work was carried out on the planted areas.

Government Plantations cloves have a reputation for good quality and the prices fetched may be taken as indicative of the trend of prices for best quality Zanzibar cloves. For ordinary Zanzibar cloves in February and July the price touched Rs. 8 per frasilas for consignments bought for a special purpose at a special price. Only seldom did the price rise above Rs. 7 and in December it dropped to Rs. 5-50. The average price for Government Plantations cloves sold during 1933 was Rs. 7-05 per frasila (the lowest since 1902) and it is calculated that a bare profit can be made on a private plantation with cloves at Rs. 6-50 per frasila.

The 1933 crop of clove stems amounting to 1,150½ frasilas realized an average price of Rs. 1-55 per frasila, which is in excess of the average local price.

Coconut and Copra.—The coconut crop was a good one, for the four gatherings yielded a total of 35,30,470 coconuts, which gave an average yield of 39.28 nuts per bearing tree for the year. The average for 1932 was 31.95 nuts. Whole nuts sold amounted to 7,61,386 of which 90,000 realized Rs. 23 per 1,000 as being selected nuts sold to Italian Somaliland for seed purposes. For the remainder, sold ex-heap on the plantations, the price realized per 1,000 fell from Rs. 15 in March to Rs. 8 in December. There was a corresponding fall in the prices obtained for leased crops from 9 cents per tree for the first quarter to 2-2 cents for the fourth quarter.

The amount of copra produced was 28,238 frasilas, which worked out at 10.72 frasilas per 1,000 nuts; thus 5,967½ nuts were required to produce one ton of copra. The corresponding figures for 1932 were 10.73 frasilas per 1,000 nuts and 5,965 nuts per ton of copra.

The local market price for copra fell during the first four months of the year from Rs. 2-06 cts. to Rs. 1-32 cts. per frasila; it rose to Rs. 1-68 cts. in June and fell again to Rs. 1-12 cts. in August. The average price onwards was Rs. 1-06 cts. and at the very end of the year the price receded to 94 cents, making an average for the year of Rs. 1-38 cts. per frasila. For the last five months of the year the price was approximately half of that for the corresponding period in 1932. During the year 27,679 frasilas were sold at an average price of Rs. 1-52 cents per frasila; the average price for 1932 was Rs. 2-34 cents. Plantations copra always fetches a premium on ordinary Zanzibar Copra and is bought for local milling.

Sundried copra was produced on the Mtoni and Chukwani estates as weather permitted, but the bulk of plantations copra is kiln-dried. Good quality copra can readily be turned out from the locally constructed kilns, which are of a simple and inexpensive type, requiring only a few old railway metals, empty tar drums and sheets of corrugated iron to convert a simple excavation into a kiln which can be cheaply and effectively roofed with palm leaf mats ("makuti").

Older palms seem to have withstood the drought very well; young palms, especially those recently planted suffered considerably, and there were numerous failures in the regenerated areas at Machui and Selem. There was a marked decrease in the quantity of nuts harvested in the fourth gathering; this was probably due in a large measure to drought conditions, but the full effects of the drought will be reflected in the 1934 crop.

Cultivation costs have been reduced to a minimum by carrying out only occasional slashing. Regeneration was carried out on certain areas which were sparsely and irregularly planted with old palms, many of which were uneconomic and were cut out to facilitate new planting on a regular system. Other areas, regenerated several years ago, were thinned of old and uneconomic trees, much to the benefit of the young palms.

General.—Only essential repairs to buildings and copra kilns were carried out. The second half of the concrete *sakafu* at Selem was reconstructed and the whole of the Machui *sakafu* was reconstructed and extended at a cost of Rs. 2,700. Various roads have been drained, and repaired. The field staff was reduced during the year to a final complement of two Head Overseers—Range III, nine Assistant Overseers—Range IV, one Headman—Range IV, and four Headmen—Menial Grade.

Labour has been plentiful (except for a slight shortage of pickers in July) in spite of reductions in wages and task rates.

Ordinary labour was of mainland origin and was paid at the rate of eight annas per day; a reduction of 11.1%. Rates for local labour engaged on coconut gathering and copra factories were reduced thus:—Climbers by 22% to one pice per tree; collectors by 37.5% to five annas per day; gatherers by 25% to Rs. 1-50 per 1,000 nuts; huskers by 19% to 13 annas per 1,000 nuts; and breakers by 14.3% to Rs. 1-50 per 1,000 nuts. Even yet production costs are too high, considering the low level of copra prices.

The quality of the labour has been up to the usual standard and the general health has been satisfactory. A total of 56,468 men-days were worked during the year.

Mr. I. G. C. Squire, Manager of Plantations, was responsible for the management of the Government Plantations throughout the year. His detailed report of work, yields, costs, etc. has been placed on record.

PRODUCE INSPECTION.

During the year under review 4,018 consignments consisting of 1,43,930 bales of cloves were presented for inspection and of these 117 consignments made up of 4,794 bales failed to pass for export. The percentage of failures was 2.9% of consignments and 3.2% of bales as compared with 3% and 3% respectively for 1932 and 2.5% and 1.9% for 1931. A percentage of failures figure of 2.9% can be regarded as low, but could be reduced considerably if exporters would not attempt to dispose of their inferior stocks by mixing them with good clean cloves. The serious drop in the price of cloves is responsible in a great measure for this condition, for climatic conditions during the 1933 harvest were favourable for the production of good quality dry cloves.

During the year it was found necessary to submit 485 samples to detailed examination for excessive moisture and extraneous matter. Of these, 20 were found to contain moisture and extraneous matter in excess of the allowance, 52 (or 22.3%) to contain excessive moisture and 76 (or 24.2%) excessive extraneous matter. The following table gives the monthly details of inspection:—

Month.	Presented for Inspection		Passed.		Failed.	
	Bales.	Cons.	Bales.	Cons.	Bales.	Cons.
January	11,990	351	11,726	345	264	6
February	8,358	241	8,158	237	200	4
March	11,262	289	11,162	287	100	2
April	11,066	274	11,016	273	50	1
May	6,842	170	6,842	170	—	—
June	14,208	307	12,859	280	1,349	27
July	14,148	379	14,122	378	26	1
August	13,322	374	12,827	359	495	15
September	14,991	382	14,696	375	295	7
October	14,382	391	14,082	384	300	7
November	14,591	417	13,934	402	657	15
December	13,564	443	12,506	411	1,058	32
	<u>1,48,724</u>	<u>4,018</u>	<u>1,43,930</u>	<u>3,901</u>	<u>4,794</u>	<u>117</u>

The total number of bales passed was 1,43,930 compared with 1,10,499 for 1932; the distribution was much more even than usual, showing the usual increase in the latter half of the year when the new crop came on the market; the reduction in the rate of duty from Rs. 2-75 to Rs. 2-00 per frasila as from 1st July stimulated exports in the latter months of the year.

Prices, the details of which are given in Table II, remained disappointingly low throughout the year.

The quality of cloves exported was fair to poor. In Bombay shipments the quality was inferior to that of previous seasons. The standard of quality in Dutch East Indies and U.S.A. shipments has been low, while for London it has been fair. Low prices have been a decided factor as concerns quality and exporters have been working to the Clove Export Decree standard as a maximum instead of as a

minimum. The reduction in the standard of quality has lessened the premium for good cloves.

Bulks have been made up to suit various markets and heavy admixtures of Khoker have been incorporated in the D.E.I. and U.S.A. bulks.

China took 1,651 frasilas of "Mother of Cloves", out of a total of 1,882 frasilas exported during 1933.

CHEMICAL LABORATORY.

The Government Chemist returned from leave on 18th May, 1933. During his leave, he took a three months' course of study in soil Chemistry and Physics at Rothamsted Experimental Station, Harpenden, and Long Ashton Agricultural and Horticultural Research Station, Bristol.

The Laboratory Assistant, Mr. Kark, carried on the routine work of the Laboratory until the return of the Government Chemist. Mr. Kark then proceeded on leave from 23rd May to 11th December, during which period he undertook a four months' course of practical work on soil analysis at the Punjab Agricultural College, Lyallpur.

The transfer of the examination of export clove samples to the Produce Inspection Branch has relieved the Laboratory of much routine work and allowed of more time being devoted to agricultural investigations. General analytical work for other Departments remains practically unchanged. The following table gives details for such work as apart from agricultural investigations.

TABLE.

Department.	1st Quarter	2nd Quarter.	3rd Quarter.	4th Quarter.	Total 1933.	Total 1932.
Agricultural	58	58	2	2	120	798
Health	17	28	43	32	120	24
Police	—	3	2	7	12	84
Customs	—	7	—	4	11	20
Other Departments	—	8	3	3	14	18
Total Government	75	104	50	48	277	944
Private	1	—	—	1	2	1
Total	76	104	50	49	279	945

Notes on Samples Examined.—The routine agricultural samples present no feature of special interest. As in previous years samples (17) of citrus fruits from the young trees were examined and gave satisfactory figures for the "soluble solids/acid ratio" and juice content.

The Health Department submitted seventy samples of soda-water and twenty-seven of sweetened mineral waters. Samples from the Zanzibar factories were satisfactory with one exception, but more

than half of the soda-waters and all the sweetened minerals from Pemba contained excessive amounts of copper.

Other samples examined for the Health Department included six cattle dips, three drinking waters, a cider and a parcel of Indian medicines. The organs of a chicken and the food believed to have caused its death contained no poisonous substance.

Six out of nine samples of cow's milk were below the recently adopted standards of 3 per cent. fat and 8.5 per cent. solids-not-fat. In three cases the deficiency in solids-not-fat was 24.2, 36.0 and 41.8 per cent. respectively. A sample of buffalo milk contained 10 per cent. of fat and 10 per cent. of solids-not-fat.

Exhibits from the Police were fewer than usual. Opium was identified in four cases and Bhang in three. Other exhibits included whisky, vermouth, native liquor, a plant root and a suspected drug (identified as acetanilide).

The Customs Department also submitted less work than in previous years. No dangerous drugs were found in five imported medicines. Alcohol was determined in three essences: two perfumes proved to be non-alcoholic. The new Order concerning the denaturing of methylated spirit led to two samples both of which were found to comply with requirements.

The Public Works Department took advantage of the facilities of the Laboratory for the examination of specimens of corroded cast-iron piping, asbestos-cement piping, etc. and the Electricity Branch submitted three lubricating oils for viscosity determinations and a large steel engine bolt for microscopic examination for evidence of fracture.

Detailed reports were made on two samples of water from the main from which the supply for ships is drawn.

Agricultural Investigations.—The Soil Chemist of the East African Agricultural Research Station, Amani, visited the Protectorate from 16th to 28th September and in company with the Government Chemist made a general survey of soils in Zanzibar and Pemba. Numerous profile samples were taken for subsequent analysis and for co-ordination with the Soil Survey of East Africa. A report on this visit has since been submitted.

A preliminary investigation of the development of oil in the growing clove bud was commenced during the main crop harvest of 1933. Further investigation is necessary, but certain general conclusions may meantime be recorded.

(i) Oil is developed in the clove bud from its earliest stages and increases in rough proportion to the total weight until the bud reaches the "all-pink" stage. Thereafter there is a falling-off in percentage oil content although the actual amount of oil in the individual clove diminishes to a much smaller extent.

(ii) The range of development which is correct for picking for the production of good spice cloves is also the range which yields the best cloves for distillation.

(iii) The percentage yield of dry cloves to be obtained from green cloves is roughly constant—36 to 37 per cent. under ideal conditions—at all stages suitable for picking.

Investigations connected with the drying and storage of cloves have been initiated. With a view to gaining further knowledge on the question of artificial drying of cloves small scale experiments were carried out on artificial drying in an electric oven. Observations on controlled drying by this method will be used as a basis for further investigations. The darkening of cloves on drying has also been investigated; this appears to be due to oxidation, accelerated by some principle present in the clove bud which can evidently be destroyed by a short preliminary scalding in boiling water. Cloves dried after scalding are light brown in colour; the same effect on colour can be produced by drying in an atmosphere deprived of oxygen. Further necessary work is contemplated.

The changes which take place in dried cloves in storage under varying conditions and for varying periods, particularly long periods, had never previously been studied; accordingly a long-term experiment was commenced in which bagged cloves of varying quality are being stored under conditions approximating to those prevailing in commercial practice.

In connexion with the consideration of fixing a grade of cloves suitable for distilling purposes, the question of the oil content of "Khoker" cloves was investigated, and it was found that the oil content varies with age, that considerable deterioration may take place on prolonged storage, but that reasonable new "Khoker" is as rich in oil as good cloves.

Analyses were made of samples of stemmed and unstemmed cloves from a trial shipment to a firm of distillers in the U.S.A. At the end of the year an investigation was in progress on the distillation of Petitgrain Oil from the leaves of the local varieties of Bitter Orange trees.

A. J. FINDLAY,

Director of Agriculture.

APPENDIX.

TABLE I.

Protectorate Clove Crops for the Past 35 Seasons:—

Season.	Zanzibar	Pemba.	Total.
	Fras.	Fras.	Fras.
1898/99	145,000	466,000	611,000
1899/1900	64,000	221,000	285,000
1900/01	37,000	200,000	237,000
1901/02	44,000	333,000	377,000
1902/03	172,000	252,000	424,000
1903/04	27,000	99,000	126,000
1904/05	81,000	654,000	735,000
1905/06	178,435	129,735	308,170
1906/07	63,004	203,496	266,500
1907/08	213,662	541,993	755,655
1908/09	165,727	449,691	615,418
1909/10	109,678	300,047	409,725
1910/11	52,100	139,307	191,407
1911/12	216,507	582,153	793,660
1912/13	31,018	104,368	135,386
1913/14	145,586	638,094	783,680
1914/15	194,920	331,389	526,309
1915/16	141,641	655,116	796,757
1916/17	208,716	302,919	511,635
1917/18	63,958	234,239	298,197
1918/19	259,273	565,229	824,502
1919/20	93,847	168,703	262,550
1920/21	231,831	316,446	548,277
1921/22	65,819	200,983	266,802
1922/23	291,417	690,498	981,915
1923/24	75,027	236,767	311,794
1924/25	240,952	520,490	761,442
1925/26	219,192	392,622	611,814
1926/27	203,843	529,186	733,029
1927/28	190,370	500,382	690,752
1928/29	74,828	125,740	200,568
1929/30	318,647	610,296	928,943
1930/31	51,796	201,320	253,116
1931/32	175,070	760,786	935,856
1932/33	242,772	244,594	487,366
Average 35 Seasons	145,418	368,617	514,035

TABLE II.

Monthly Average Price of Cloves—Local.

Month.	1932.			1933.				
			Stems. Rs. per fras.	Duty on				Duty on Cloves. Rs. per fras.
	Zanzibar.	Pemba.		Cloves.	Zanzibar.	Pemba.	Stems.	
	Rs. per fras.	Rs. per fras.		Rs. per fras.	Rs. per fras.	Rs. per fras.	Rs. per fras.	
January	12.31	11.69	2.69	1.80	9.54	8.34	1.75	2.75
February	11.76	11.55	2.70	1.80	9.94	8.98	1.81	2.75
March	12.75	12.50	2.46	3.00	9.28	8.70	1.81	2.75
April	11.84	11.75	2.25	3.00	9.14	8.53	1.83	2.75
May	12.41	12.12	2.40	3.00	8.90	8.32	1.70	2.75
June	11.69	11.30	2.04	3.00	10.32	9.82	1.80	2.75
July	11.63	11.33	1.79	2.75	8.60	8.20	1.77	2.00
August	11.84	11.54	1.90	2.75	7.96	7.46	1.76	2.00
September	11.27	10.46	2.09	2.75	8.12	7.50	1.78	2.00
October	10.80	10.08	2.15	2.75	7.77	7.32	1.64	2.00
November	10.75	10.12	2.13	2.75	7.89	7.08	1.66	2.00
December	9.94	9.43	2.12	2.75	7.43	6.92	1.70	2.00
Yearly Average	11.58	11.16	2.23	2.67	8.74	8.10	1.75	2.37

All the above prices are "duty paid".

Prices for Stems are F.O.B.

TABLE III.

Exports of Cloves and Clove Stems.

Month	1932.		1933.	
	Cloves. Frasilas.	Clove Stems. Frasilas.	Cloves. Frasilas.	Clove Stems. Frasilas.
January	66,765	10,947	58,678	9,213
February	1,33,738	23,584	43,603	13,162
March	7,888	5,430	54,618	16,320
April	11,600	3,430	53,126	13,040
May	13,658	8,154	32,638	12,299
June	20,531	2,480	19,142	4,661
July	31,373	8,176	1,00,784	19,742
August	43,699	7,520	64,868	15,514
September	52,534	11,782	63,555	15,237
October	49,594	11,850	66,948	19,633
November	50,970	18,234	67,863	15,192
December	36,208	13,990	63,216	17,527
Totals	5,18,558	1,25,577	6,89,039	1,71,540

TABLE IV.

Destinations of Clove and Clove Stem Exports.

	1932.		1933.	
	Cloves. Fras.	Stems. Fras.	Cloves. Fras.	Stems. Fras.
Great Britain and Northern Ireland	... 44,972	49,341	82,320	54,944
India	... 1,99,584	2,390	2,20,544	2,947
Straits Settlements	... 8,451	2,658	7,696	2,630
Canada	... 2,173	80	4,250	80
Union of South Africa	... 1,005	106	2,941	166
Tanganyika Territory	... 134	3	160	—
Kenya Colony	... 355	—	355	—
Australia	... 1,824	—	6,470	—
Aden	... 4,074	—	4,038	—
Ceylon	... 131	—	477	—
New Zealand	... 477	—	774	—
Cyprus	... 64	—	128	—
Cuba	... 99	—	—	—
Dutch East Indies	... 1,29,350	5,725	2,23,185	17,181
United States of America	... 78,598	—	99,393	3
Mexico	... 582	—	390	—
Madagascar	... —	—	—	—
Germany	... 11,658	63,190	6,947	89,987
Italy	... 4,563	1,002	3,990	202
Japan	... 1,674	598	4,090	915
Holland	... 16,336	—	3,219	2,400
China	... 1,325	170	1,037	74
Poland	... 42	—	102	—
Arabia	... 429	—	250	—
Turkey	... 106	—	64	—
Egypt	... 5,261	13	6,723	—
Brazil	... 605	—	1,142	—
Sweden	... 198	—	1,110	—
Uruguay	... 99	—	—	—
Mauritius	... 106	—	106	—
Denmark	... 400	—	499	—
Tripoli	... 102	—	—	—
Norway	... 202	—	202	—
Portuguese East Africa	... 45	—	67	—
Persia	... 125	—	387	—
Italian Somaliland	... 96	—	64	—
Greece	... 282	—	320	—
French Somaliland	... 173	—	704	10
Spain	... 2,624	—	1,501	—
Argentina	... 249	—	1,728	—
Malta	... —	—	99	—
British Guiana	... —	—	80	—
Belgium	... —	—	506	—
Iraq	... —	—	614	—
Danzig (Free State)	... —	—	301	—
Portuguese India	... —	—	67	—
France	... —	102	—	—
Total	... 5,18,573	1,25,578	6,89,040	1,71,539

TABLE V.

Monthly Average Price of Copra—Local.

Month.	1932.	1933.
	per frasila. Rs. Cts.	per frasila. Rs. Cts.
January	2 17	1 98
February	2 62	1 75
March	2 43	1 67
April	2 13	1 43
May	2 06	1 42
June	1 90	1 51
July	1 97	1 46
August	2 10	1 24
September	2 12	1 16
October	2 13	1 03
November	2 08	1 07
December	2 12	1 05
Yearly Average	<u>2 15</u>	<u>1 40</u>

TABLE VI A.
METEOROLOGICAL OBSERVATIONS—1933.
RAINFALL AND RELATIVE HUMIDITY—ZANZIBAR.

Months	Salem		Kidichi		Machui		Mkokotoni		Chwaka		Town		Kizimbani		Dunga		Chukwani	
	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %	Rain	Wet Days	Average Relative Humidity %	Wet Days
January	7.59	18	7.37	14	5.46	15	1.12	2	3.70	6	5.07	14	80	6.13	15	81	5.91	16
February	4.23	5	2.63	5	1.83	6	0.45	1	0.23	2	3.25	5	80	1.74	9	83	1.87	6
March	3.85	9	4.52	11	7.98	15	1.41	5	7.22	12	2.63	6	80	6.69	16	80	6.06	16
April	7.71	11	8.88	14	9.18	13	1.00	5	5.45	7	7.64	7	78	8.77	15	79	7.41	15
May	6.11	8	6.42	6	8.25	9	1.92	6	13.02	11	4.51	9	81	7.18	8	83	8.74	12
June	0.63	4	0.26	2	0.65	5	0.20	1	1.64	5	0.46	4	81	0.47	5	81	0.97	7
July	1.45	6	1.03	2	1.68	10	1.16	5	1.57	11	0.97	3	80	1.04	8	79	1.97	14
August	4.11	13	3.42	7	5.45	10	3.06	10	0.92	7	2.39	8	79	4.51	13	77	1.72	10
September	1.52	12	1.97	11	1.60	12	1.11	3	0.99	5	0.57	7	78	1.55	14	76	0.62	10
October	2.96	13	5.63	12	4.52	14	0.80	3	0.10	1	3.37	9	78	5.71	13	75	4.33	13
November	8.42	19	7.68	17	9.68	15	2.03	3	2.79	4	10.19	13	78	7.58	17	77	6.81	17
December	4.25	9	6.23	14	5.09	13	2.75	3	2.37	7	6.49	15	79	3.84	12	74	3.66	14
Total 1933	52.83	127	55.99	115	61.37	137	17.01	47	40.00	78	47.54	100	79	55.21	145	79	50.07	150
Total 1932	64.04	149	64.69	135	...	...	...	...	53.19	54	62.04	121	...	...	...	...	51.04	136

Note :—Rainfall in Inches.

TABLE VI B.

METEOROLOGICAL OBSERVATIONS—1933.

RAINFALL AND RELATIVE HUMIDITY. PEMBA.

Months	Wete		Mkoani		Mtambili		Kigoma		Makondeni		Wesha		Fufuni	
	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Rain	Wet Days	Average Relative Humidity %	Average Relative Humidity %
January	6.35	14	11.65	19	14.90	21	5.72	11	...	...	12.38	18	84	13.78
February	0.85	3	0.27	3	1.51	7	0.11	1	...	...	0.68	4	82	1.55
March	7.55	7	9.52	13	7.78	16	8.26	4	...	...	7.44	9	82	4.94
April	5.17	16	7.37	12	6.35	15	7.06	9	...	...	6.96	13	82	4.97
May	8.00	13	5.35	15	8.13	16	6.36	10	7.55	12	7.94	14	83	5.09
June	3.05	9	2.16	12	4.66	12	4.30	6	2.86	10	1.84	8	81	2.47
July	1.82	9	2.71	12	3.73	14	3.14	11	3.61	15	2.01	14	78	2.17
August	1.85	6	0.94	7	2.12	9	2.83	6	0.75	3	1.12	6	78	0.47
September	0.55	6	1.46	6	0.87	11	2.59	8	0.52	4	0.22	4	72	0.54
October	0.38	4	0.39	3	0.35	3	4.76	6	1.02	6	0.31	4	71	0.19
November	10.11	14	10.18	18	8.05	20	3.23	5	5.98	13	5.97	16	74	8.61
December	7.70	13	10.22	14	6.98	18	1.54	3	4.82	9	3.71	19	77	13.33
Total 1933	53.38	114	62.33	134	65.03	162	49.90	80	27.11	72	50.58	128	79	58.16
Total 1932	73.93	153	63.84	172	83.41	179	76.22	101	...	...	63.52	176	...	73.66

Note:—Rainfall in Inches.

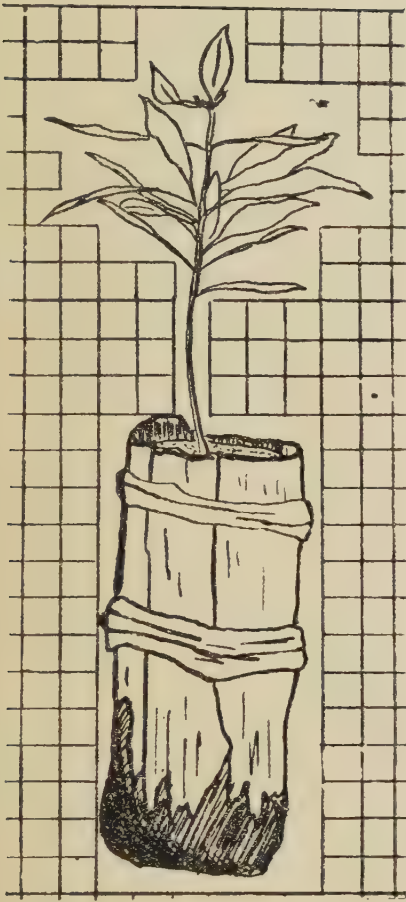
TABLE VI C.
METEOROLOGICAL OBSERVATIONS—1933.

TEMPERATURES.

	Z A N Z I B A R										P E M B A			
	Town				Kizimbani				Dunga		Chukwani			
	Mean		Max.		Mean		Min.		Mean	Max.	Mean	Min.	Mean	Max.
January	85.3	79.9	87.0	74.1	87.9	73.5	87.2	76.6	86.9	73.6	86.7	72.2	86.0	72.2
February	87.2	82.9	88.8	73.9	89.6	72.4	89.8	76.7	89.9	74.0	88.3	72.3	89.9	74.0
March	87.8	80.6	88.4	73.6	89.2	72.3	90.4	77.3	89.7	74.9	88.0	74.0	89.7	74.0
April	87.4	79.6	87.0	73.5	89.1	71.7	89.1	77.1	88.8	74.8	86.7	75.3	88.8	75.3
May	84.4	76.6	84.6	71.6	86.8	70.2	84.2	75.3	84.0	73.1	83.4	75.0	84.0	75.0
June	82.7	74.3	83.5	69.3	85.3	65.2	82.8	72.8	82.3	70.8	82.1	72.7	82.3	72.7
July	81.6	73.6	82.4	68.7	83.9	66.9	81.4	72.1	81.5	70.3	80.9	72.5	81.5	72.5
August	81.6	73.3	82.2	67.4	84.4	65.1	81.7	71.7	82.5	68.0	80.9	71.1	82.5	71.1
September	82.1	73.8	82.0	67.0	84.5	64.5	82.7	71.8	83.8	69.1	82.2	70.6	83.8	70.6
October	83.8	75.0	83.8	67.6	84.6	65.5	85.0	72.0	87.6	70.4	84.8	70.0	87.6	70.0
November	84.4	77.2	85.8	70.7	86.8	69.0	86.5	74.0	87.2	72.5	86.6	70.6	87.2	70.6
December	86.3	79.2	88.0	72.6	88.6	72.0	87.5	75.3	88.1	73.7	87.5	70.9	88.1	70.9
For the year	84.6	77.2	85.3	70.8	86.7	69.1	85.7	74.4	86.0	72.2	84.8	72.2	86.0	72.2

Note 1.—Temperatures in Degrees Fahrenheit.

PLATE A.



TRANSPLANT. 12 months old.

BANANA LEAF-BASE POT.

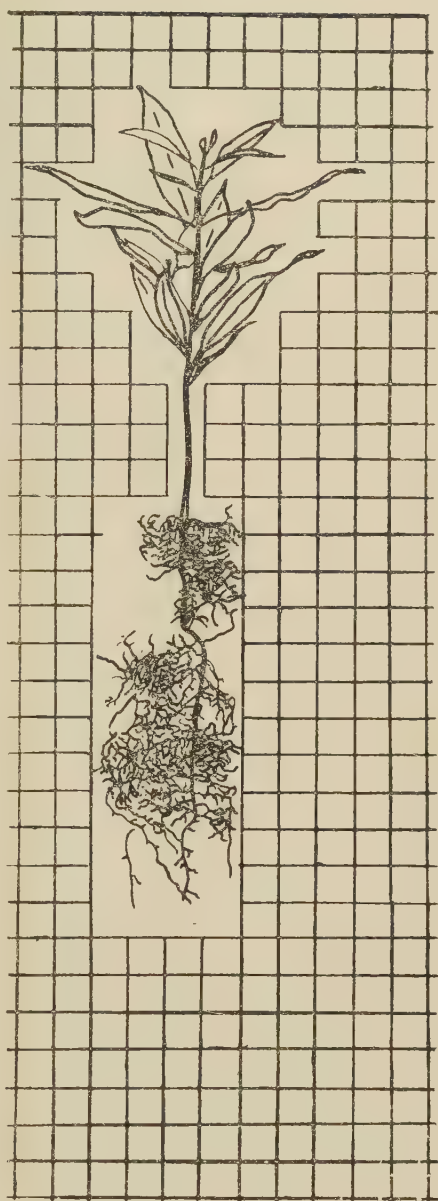
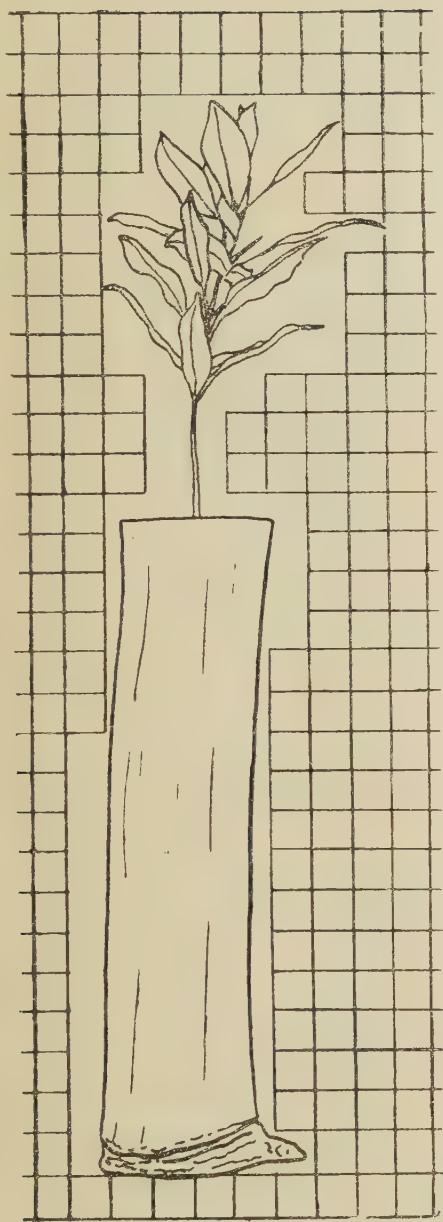
NOTE:—Early potting results in collapse of earth cylinder and pot necessitating repotting with consequent twisting of the main root.

(Grid in one inch squares.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	52
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[illegible]
$$1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10 \quad 11 \quad 12 \quad 13 \quad 14 \quad 15 \quad 16 \quad 17 \quad 18 \quad 19 \quad 20 \quad 21 \quad 22 \quad 23 \quad 24 \quad 25 \quad 26 \quad 27 \quad 28 \quad 29 \quad 30 \quad 31 \quad 32 \quad 33 \quad 34 \quad 35 \quad 36 \quad 37 \quad 38 \quad 39 \quad 40 \quad 41 \quad 42 \quad 43 \quad 44 \quad 45 \quad 46 \quad 47 \quad 48 \quad 49 \quad 50 \quad 51 \quad 52 \quad 53 \quad 54 \quad 55 \quad 56 \quad 57 \quad 58 \quad 59 \quad 60 \quad 61 \quad 62 \quad 63 \quad 64 \quad 65 \quad 66 \quad 67 \quad 68 \quad 69 \quad 70 \quad 71 \quad 72 \quad 73 \quad 74 \quad 75 \quad 76 \quad 77 \quad 78 \quad 79 \quad 80 \quad 81 \quad 82 \quad 83 \quad 84 \quad 85 \quad 86 \quad 87 \quad 88 \quad 89 \quad 90 \quad 91 \quad 92 \quad 93 \quad 94 \quad 95 \quad 96 \quad 97 \quad 98 \quad 99 \quad 100$$
[illegible]

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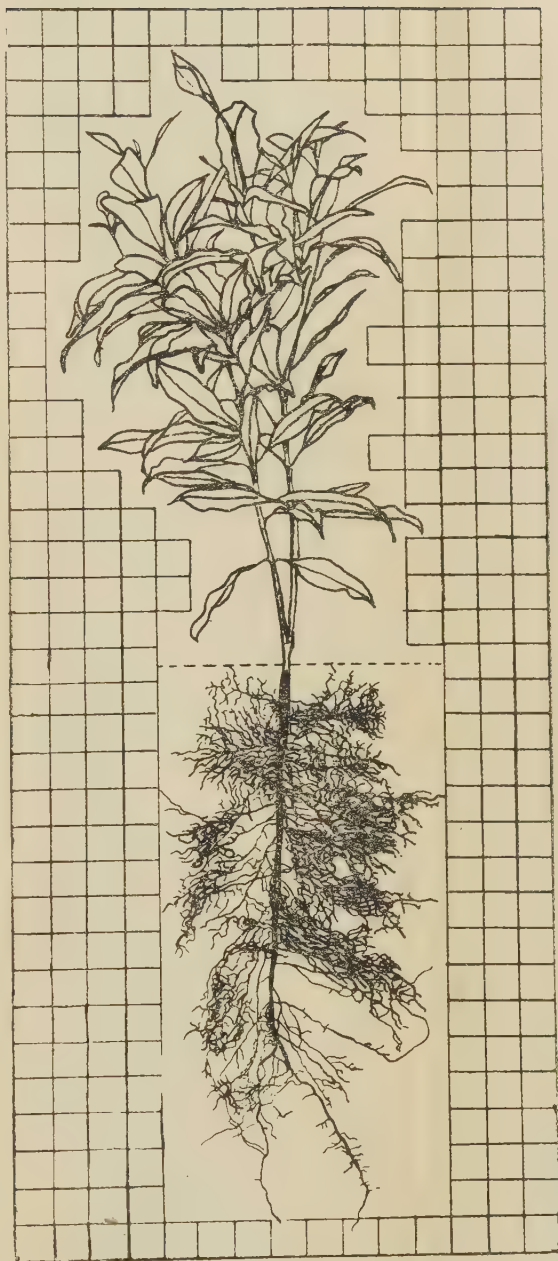
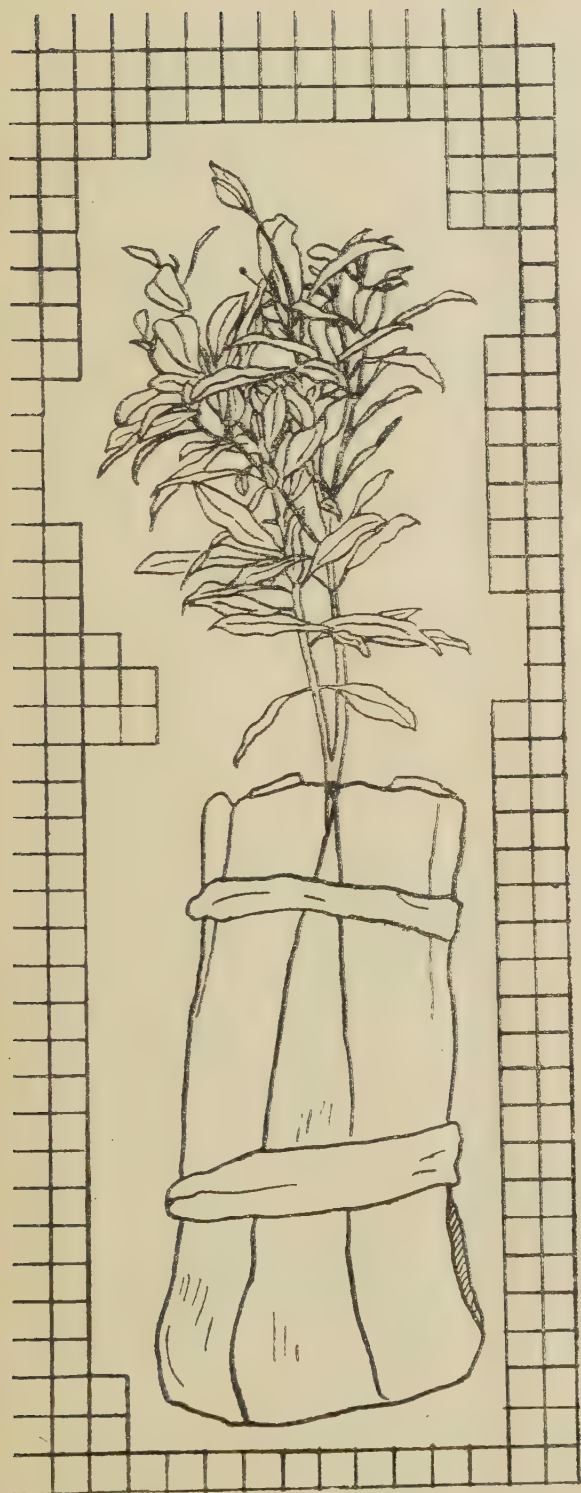


TRANSPLANT. 12 months old.

BAMBOO POT.

NOTE:—Constriction of the lateral root system due to small diameter of the pot. Poor aeration in middle soil level resulting in local starvation of the root system. No collapse of earth cylinder.

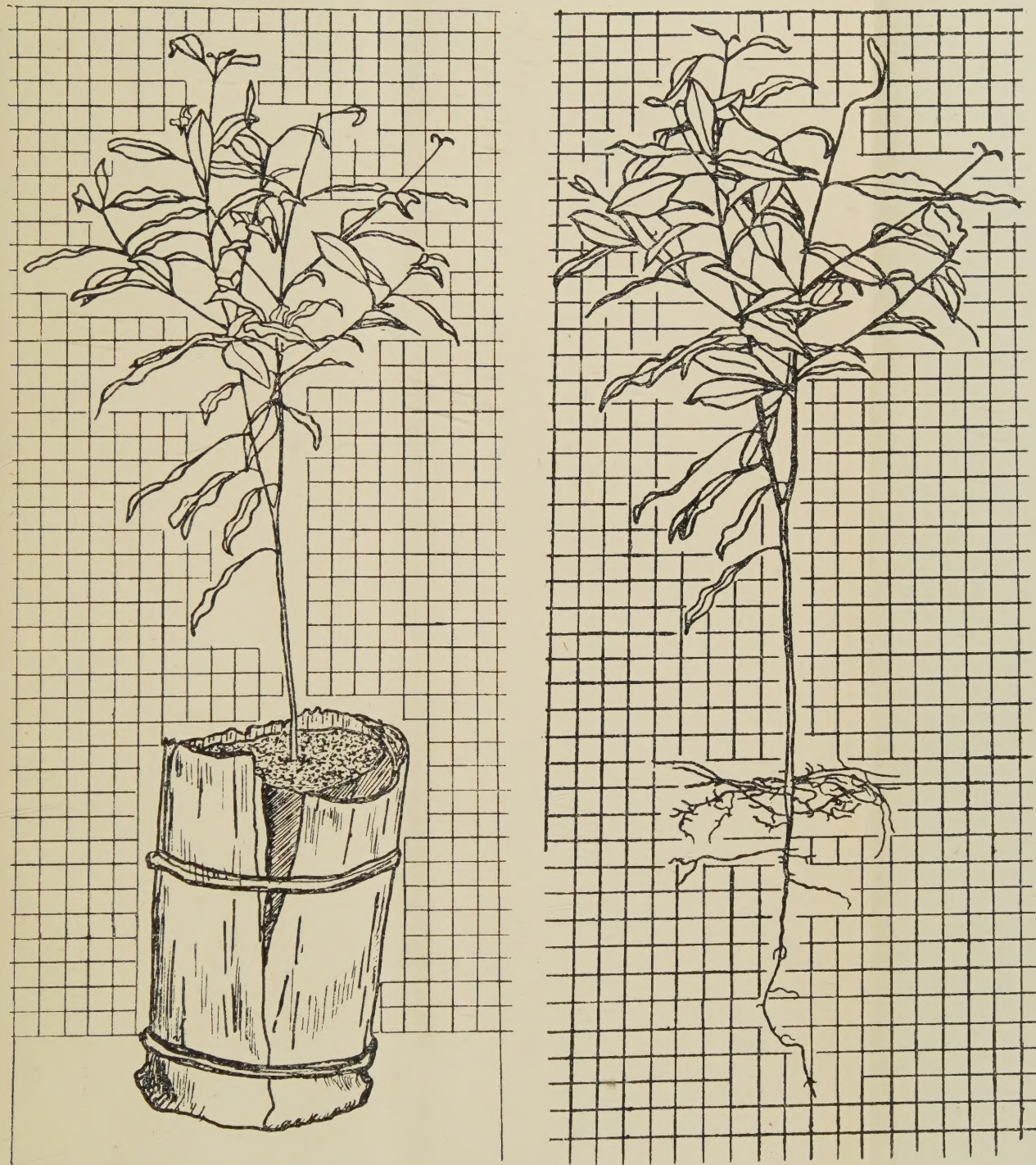
A promising method with bamboo pots of greater diameter.
(Grid in one inch squares.)



HARDENED-OFF SEEDLING. 12 months old.

NOTE:—Lifted with cylinder of earthen 6" by 15", wrapped in green banana leaf-base, for immediate transport and estate planting. Strong root and shoot system with sun-leaf equipment.
(Grid in one inch squares.)

PLATE D.



NATURAL SEEDLING (BOTEA) 4 to 6 years old showing approximately twelve growing seasons. Large specimen lifted with ball of earth 16" by 10"; extensively used for estate planting.

NOTE:—Absence of feeding roots, long whippy stems, large shade leaves.

(Grid in one inch squares.)

